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AN ENVIRONMENTAL EVALUATION
OF THE
PROPOSED VERMILION RECREATION DAM AND TROUT POND

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(102)

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1.0 INTRODUCTION

The location of the proposed Vermilion Recreation Dam and Trout Pond site is along the southern perimeter of Vermilion Provincial Park. The park is situated immediately northwest of the Town of Vermilion along the Vermilion River (Reservoir). The project site is located on the upper end of a ravine which extends north down into the Vermilion River (Reservoir). The proposed dam will block a small intermittent stream which flows through the ravine (Figure 1).

The Vermilion Recreation Dam and Trout Pond Project consists of an earth-filled dam with a drop inlet and emergency spillway and saddle dykes which enclose most of the pond. In addition, excavation work is necessary to create the trout pond (Figure 2). The dam will normally maintain the water level of the trout pond between 607.8 m and 607.15 m elevation. This water level elevation is above the top of the ravine, thus, saddle dykes are necessary to contain the pond (Alberta Environment, 1989). Borrow materials for the dam and saddle dykes will originate from the pond excavation work (Alberta Environment, 1989).

The Vermilion Recreation Dam and Trout Pond Project is part of an upgrade in the provincial park undertaken by Alberta Recreation and Parks. Alberta Environment's involvement in this upgrade is limited to the construction of the trout pond, the dam, and the saddle dykes which will surround the pond. This Environmental Evaluation is limited to the portion of the park upgrade in which Alberta Environment is involved: the dam, the pond, the area immediately surrounding the pond, and the outflow of the pond to the Vermilion River (Reservoir).

As part of this Environmental Evaluation, two site inspections were conducted, one at the proposed project area near Vermilion and the other at Bud Miller All Seasons Park in Lloydminster. The Bud Miller Park has a trout pond which is similar to the proposed project, both in design and

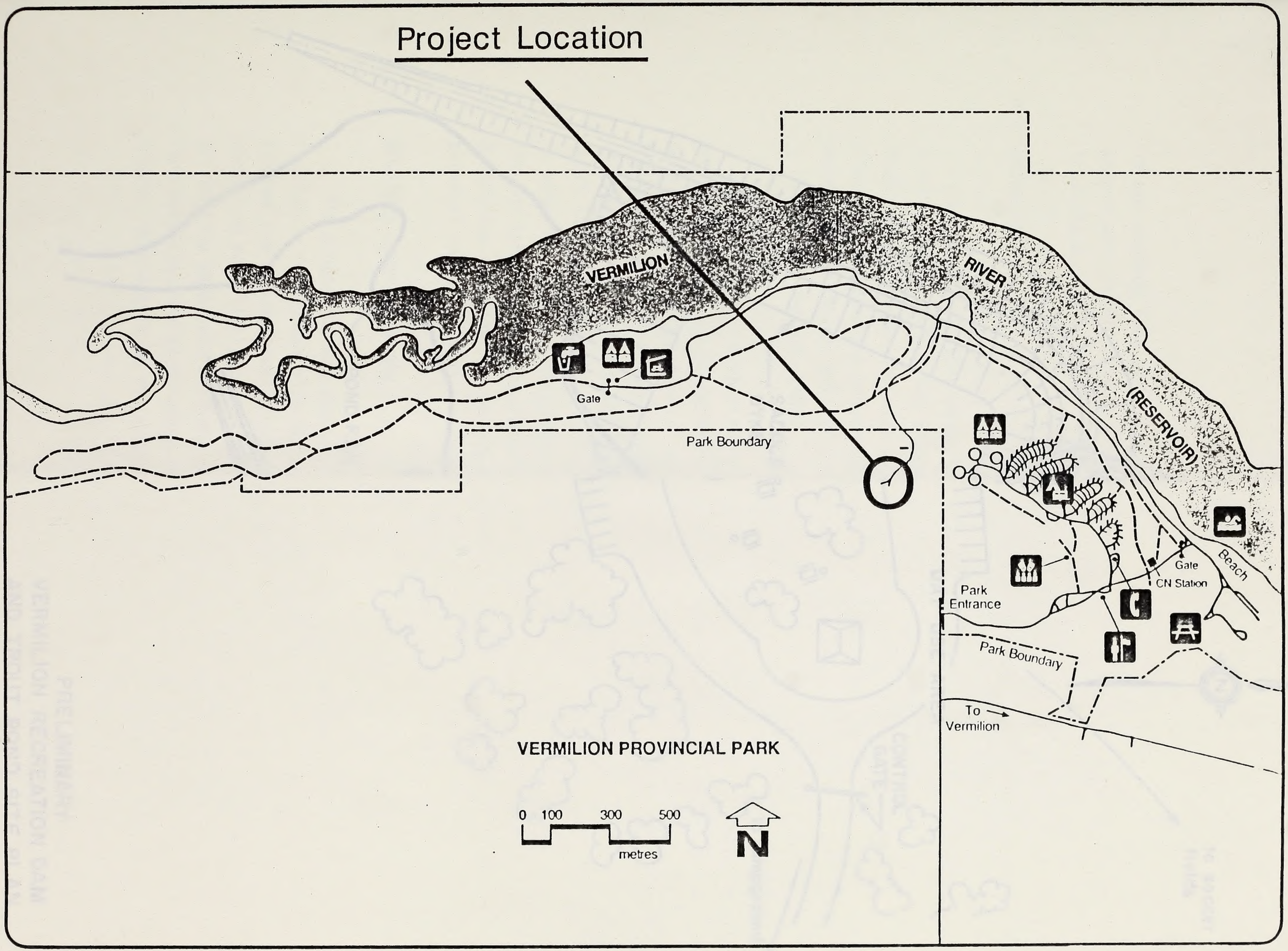
Project Location
VERMILION
RIVER
(RESERVOIR)
Gate
Park Boundary
Beach
Gate
CN Station
Park Entrance
Park Boundary
To Vermilion
VERMILION PROVINCIAL PARK
0 100 300 500
metres
N

Figure 1.

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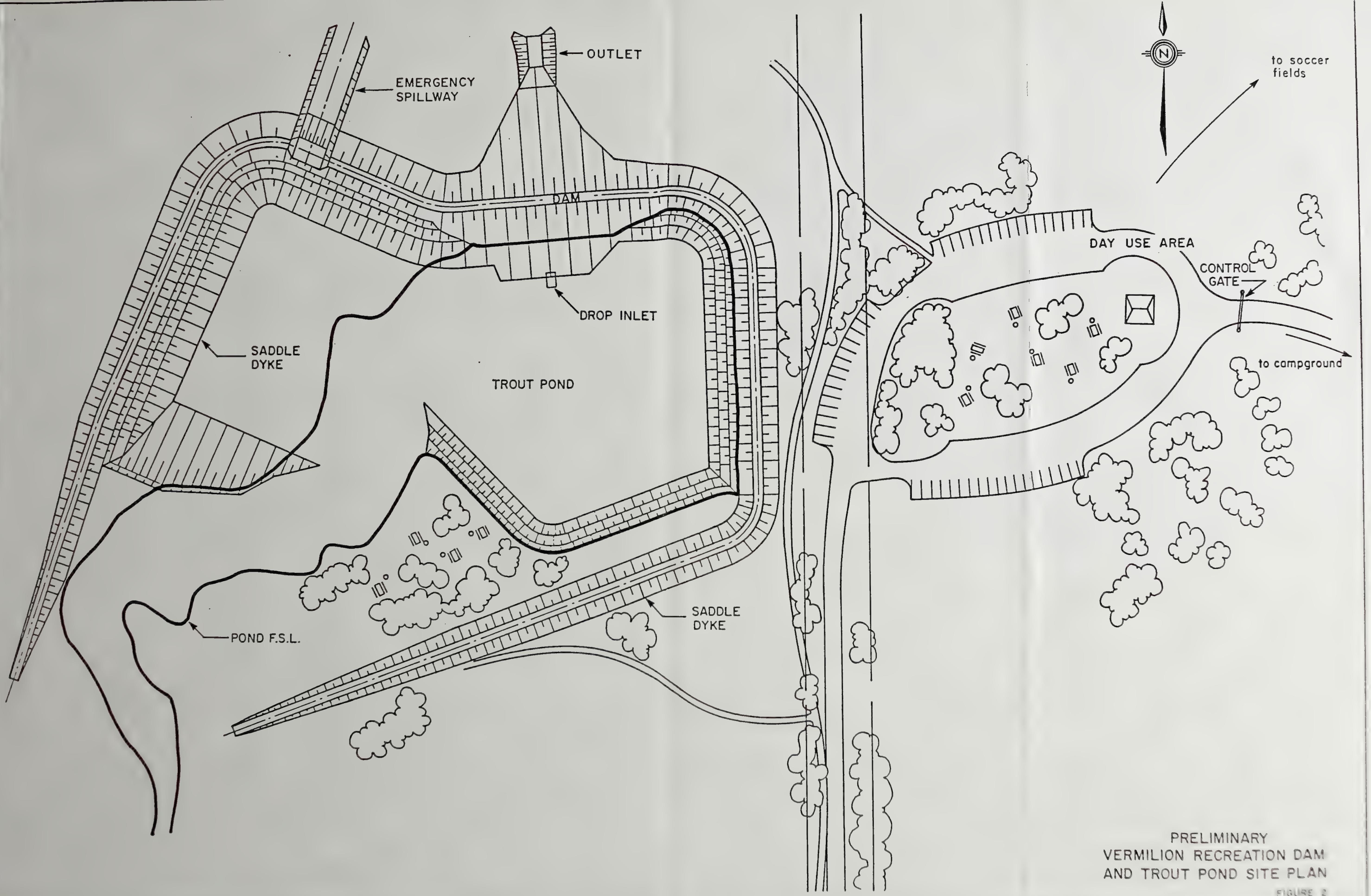

PRELIMINARY
VERMILION RECREATION DAM
AND TROUT POND SITE PLAN

FIGURE 2

in surrounding land use. These similarities allowed for useful comparisons between the two in projecting water quality for the Vermilion Trout Pond.

2.0 HYDROLOGY

At the Full Supply Level (FSL) of 607.80 m, the trout pond will have a surface area of 2.2 ha, a mean depth of 3.55 m, a total volume of 78.0 dam^3, and a maximum depth of 7.1 m. The pond has an estimated drainage area of 1.9 km^2 and a calculated mean yearly inflow of 75.0 dam^3. The mean yearly turnover rate of water in the pond is estimated to be 96% (Alberta Environment, 1989).

Water for the pond will initially be supplied by pumping water from the Vermilion River (Reservoir). Once at FSL, the pond will receive make-up water in the form of runoff from the drainage basin. The pond FSL is controlled by a drop inlet (see Figure 2). Excess water entering the pond flows into the drop inlet and is then directed below the dam where it will follow the small natural channel present in the ravine. It is expected that the discharge from the pond will closely resemble natural conditions (i.e., intermittent flow). The pond will reduce downstream discharge rates slightly during flood events (A. Deboer, personal communication).

2.1 Drilling Investigations

The proposed trout pond and dam site will be further evaluated for foundation conditions with test boreholes. In 1976, test holes were drilled 200 m downstream of the present project site. Conditions indicated very little potential for water loss from the test area to the surrounding materials. If the new test boreholes show that there are incorrectable conditions which result in significant water loss, then the project site should be relocated.

3.0 PROJECT IMPACTS

Relative to other developments being undertaken by Recreation and Parks in the vicinity, the presence and construction of the Vermilion Recreation Dam and Trout Pond is expected to have minimal land and water impacts. Soccer fields, day-use areas, parking lots, and supporting infrastructure were scheduled for construction starting in the spring of 1990, however construction has been delayed. Construction of the proposed dam and trout pond is scheduled for the fall of 1990 (J. McClung, personal communication).

Specific land use capabilities, land descriptions, and project impacts on the project area are shown in Table 1. Some of the information on this table was obtained through communication with Fish and Wildlife (J. Kneteman, St. Paul), and Recreation and Parks (W. Meikle, Vermilion Provincial Park) officials. A site inspection by Planning Division personnel was conducted on April 25, 1990, in order to refine the classifications and determine expected project impacts.

The agricultural land that will be lost as a result of this project is used to grow forage crops. Poor, rocky soils and the presence of several ravines limit the agricultural use of this land. Agriculture use of this area under these conditions is limited and the poor agricultural capability of the soil limit crop selection. The project will change the land use of the area from agriculture to recreation. The poor capability agriculture land will be returned to a more natural state, one which is more compatible with recreation activity. Natural grasses and trees will be planted in and around the project area (W. Meikle, personal communication).

The impact of the project on recreation in the Vermilion Provincial Park will generally be positive. Fishing within the Vermilion Provincial Park was limited to Northern pike in the reservoir. With the completion of this project, the opportunity to fish for a more desirable fish species, rainbow trout, will exist (J. Kneteman, personal communication).

TABLE 1
VERMILION RECREATION DAM AND TROUT POND CANADA AND ALBERTA LAND INVENTORY CLASSIFICATIONS AND PROJECT IMPACT

LAND INVENTORY	CLASSI-FICATION	DESCRIPTION	PROJECT IMPACTS
Agriculture[1]			
Project Site	6T	**Soils in this class are capable only of producing Perennial Forage Crops and Improvement Practices are not feasible.** - adverse topography: the patterns of slope limit agricultural use.	- minimal negative impact: agricultural land lost to project area is of marginal quality and is presently used for pasture. - land will be reclaimed to natural area compatible with adjacent parkland.
Upper Basin Area	2C	**Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.** - adverse climate: main limitations are low temperatures and/or low or poor distribution of rainfall during the cropping season.	- no impact; no land use changes as a result of project.
Recreation[2]			
Project Site	4KON	**Moderate Capability for Outdoor Recreation.** - shoreland or upland suited to organized camping, usually associated with other features. - land affording opportunity for viewing upland wildlife. - land (usually shoreland) suited to camping or other recreational lodging use.	- moderate positive impact: project enhances recreational suitability of area providing multiple outdoor recreation opportunities (tobogganing, skating, fishing, etc.).Increased human traffic in area may reduce opportunity for viewing upland and wetland wildlife.

TABLE 1
VERMILION RECREATION DAM AND TROUT POND CANADA AND ALBERTA LAND INVENTORY CLASSIFICATIONS AND PROJECT IMPACT (continued)

LAND INVENTORY	CLASSIFICATION	DESCRIPTION	PROJECT IMPACTS
Recreation[2]			
			- will provide opportunity for small craft human-powered boating (canoes, rowboats, paddle boats). A safer environment to undertake these activities than the larger Vermilion River (Reservoir).
Adjacent Park Area	6WOL	**Low Capability for Outdoor Recreation.** - land affording opportunity for viewing of wetland wildlife. - land affording opportunity for viewing of upland wildlife. - interesting landform features other than rock formations.	- minimal negative impact: increases in human traffic may reduce opportunity for viewing upland and wetland wildlife.
Ungulates[3]			
Project Site	1W(DM)	**Lands that have No Significant Limitations to the Production of Ungulates.** - Class I lands that are winter ranges upon which the animals from the surrounding area depend (Deer, Moose).	- moderate negative impact: removal of tree cover at upper end of ravine and increased disturbance due to human traffic will reduce quality of overwintering habitat in ravine. - major portion of ravine will remain as is.

TABLE 1
VERMILION RECREATION DAM AND TROUT POND CANADA AND ALBERTA LAND INVENTORY CLASSIFICATIONS AND PROJECT IMPACT (continued)

LAND INVENTORY	CLASSIFICATION	DESCRIPTION	PROJECT IMPACTS
Ungulates[3]			
Adjacent Park Area	2T	**Lands that have Very Slight Limitations to the Production of Ungulates.** - adverse topography: flatness of land	- minimal negative impact: the project will have minimal impact compared to other scheduled development activities in park.
Sportfish[4]			
Vermilion R.	3D	**Waters that have Several Minor Limitations or Few Serious Limitations on Sportfish Production.** - Rivers - discharge: fish habitat is greatly reduced by low discharge or extreme water level fluctuations.	- no impact: once filled, the pond will require little water to maintain water level. In most years, the intercepted runoff will pass through the system and enter the river.
Vermilion Basin	3D	- Lakes - depth: lakes have insufficient depth.	- moderate positive impact: the trout pond will provide a relatively good fishing opportunity and reduce fishing pressure on the other lakes within the basin.

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[1] Canada Land Inventory, 1970
[2] Canada Land Inventory, 1972
[3] Canada Land Inventory, 1969
[4] Alberta Land Inventory, 1977

Further, small craft human-powered boating may be done so in a safer environment on the pond, than on the reservoir.

There is concern over the potential degradation of the habitat in the ravine which continues north of the project site as a result of construction activities and increased levels of human disturbance. Ravines provide important habitat for the wildlife within the Vermilion River basin area. During the winter season, ravines provide wind and thermal shelter to wildlife and they also provide food to the many animals which inhabit them. During the site inspection, Great Horned Owls, which are protected, were observed in the ravine. Signs of extensive use of the ravine by deer, porcupines, rabbits and upland game birds were also seen.

3.1 Construction Guidelines

As the ravine provides important habitat to the wildlife in and surrounding the project area, it is recommended that construction activities should avoid the lower portions of the ravine as much as possible. Use of heavy equipment, clearing of trees, disturbance of the soil, and related activity should be limited to the area of the dam, the pond and the saddle dykes as much as possible. Alberta Environment should not upgrade any area of the ravine downstream from the project site (i.e., improve the hiking path, channelize outflow downstream of the dam). Landscaping and seeding of the area should be done as quickly as possible following construction. Planted vegetation should approximate natural conditions in the area.

To prevent excess soil erosion and minimize water quality deterioration as a result of construction activity, it is recommended that construction start after spring runoff when flow in the small intermittent creek is well below peak spring flows. Construction activity and practices according to the Master Specifications, Schedule C (Alberta Environment, Development and Operations Division, 1990), should be adequate to minimize these and other impacts during construction.

4.0 WATER QUALITY

The planned water source for the initial filling of the trout pond is the Vermilion River (Reservoir). Reservoir water used for filling the pond will be screened and effectively centrifuged during the pumping process (W. Meikle, personal communication). In addition to removing invertebrates and macrophytes from the water, this procedure will reduce the possibility of importing unwanted fish fry and eggs into the trout pond. However, the success of these measures in preventing the introduction of an undesirable plant or animal species into the trout pond is not guaranteed.

According to water quality data collected in 1971 and 1974 (Table 2), total phosphorus concentrations and ammonia concentrations in the Vermilion River (Reservoir) were 0.80 mg/L and 1.00 mg/L, respectively. According to water quality classifications, the waters are hypereutrophic (Wetzel, 1983). Hypereutrophic waters are characterized by high aquatic plant productivity, frequent algal blooms, a clinograde oxygen profile (dissolved oxygen concentrations decrease with depth to anoxic conditions in sediments), and an increased probability of fish kills. These characteristics could significantly limit the recreational potential of this project (J. Shaw, personal communication).

The Bud Miller All Season Park-Trout Pond in Lloydminster is twice the surface area (4 ha) of the proposed Vermilion Pond, the same mean depth, and has similar bank morphometry. Wind aeration would be more efficient at the Bud Miller Trout Pond, which also had better quality start up water (potable water from the town). Despite these advantages, the Bud Miller Trout Pond has water quality problems due to eutrophic conditions.

To increase dissolved oxygen concentrations in the Bud Miller Trout Pond and improve other water quality parameters, staff at the Lloydminster park aerate the pond continuously from May until ice forms on the pond in late fall. Aeration was found to be necessary to ensure the overwintering of trout in the pond. According to staff at Bud Miller Park, algae became a problem when an aeration unit breakdown occurred (D. Dwernychuk, personal communication).

TABLE 2

VERMILION RIVER (RESERVOIR) OPEN WATER - WATER QUALITY[1] JULY 1971 and APRIL 1974

Parameter Sampled	Average (mg/L)	Sample Size (n)
Nitrogen-dissolved		
NO_3 & NO_2	0.340	2
Nitrite	0.10	1
Ammonia - total	1.0	2
Dissolved Oxygen	10.20	1
Total Alkalinity	106.0	2
Phenols (total)	0.004	1
Sodium-dissolved	28.0	1
Magnesium-dissolved	10.0	1
Phosphorus - total	0.80	2
Sulphate-dissolved	60.5	2
Total Coliforms (No./100 mL)	43.0	2

[1] Source: NAQUADAT, 1990

Three water quality parameters could pose a problem to the success of the Vermilion Trout Pond: total phenols, nitrite, and ammonia. Historical data for these parameters exceed Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCREM, 1987).

The Freshwater Aquatic Life CCREM guideline for Phenolic material (Total Phenol) is 0.001 mg/L. The water sampled from the Vermilion River (Reservoir) had a concentration of 0.004 mg/L. Although phenolic compounds are toxic to aquatic life at higher concentrations (5 mg/L for Rainbow trout) (Albersmeyer and von Ericksen, 1959); taste and odour thresholds occur at much lower concentrations (0.002 mg/L). The

rationale for the CCREM 0.001 mg/L guideline is to protect taste and odour of domestic water supplies and to prevent tainting fof fish flesh (which is otherwise safe to eat).

The Freshwater Aquatic Life (CCREM, 1987) guideline for Nitrite (NO_2) is 0.06 mg/L. The rationale for this guideline is based on toxicity tests of salmonids, which are more sensitive to nitrites than some other fish species. The concentration of nitrite at which there was zero mortality of rainbow trout over ten days was 0.06 mg/L (Russo et al., 1974). Sensitivity of warm water fish species is , more variable than for salmonids (Lewis and Morris, 1986). Water samples taken from the Vermilion River (Reservoir) in 1971 and 1974, had a mean nitrite concentration below detection limits, less than 0.1 mg/L. This value, below the threshold detection limit is likely due to the analysis method used in 1971 and 1974. Therefore, it is uncertain whether the Vermilion River (Reservoir) samples exceeded the CCREM guideline. Additional sampling and analysis of reservoir waters is necessary to determine whether nitrite concentrations could be problematic.

Ammonia exists in the environment in two states, the ionized form NH_4, and the more toxic un-ionized form NH_3. These two forms exist in ionic equilibrium, therefore, ammonia toxicity can vary. CCREM recommends not one guideline value, but many values which are a function of water temperature and pH. Ammonia concentrations above the recommended values can be acutely toxic to freshwater organisms. Rainbow trout is one of the species most sensitive to ammonia concentrations. The water sampled from the reservoir had a mean ammonia concentration of 1.0 mg/L and a mean pH of 8.1. According to the CCREM Ammonia Guidelines Table, these samples would exceed the recommended ammonia levels at a water temperature of 20^oC (0.93 mg/L). These conditions could develop in the trout pond and thus, ammonia toxicity could affect trout in the pond. Exceedance of CCREM guidelines for phenols, nitrite and ammonia in the trout pond would negatively impact the fishery and thus the recreational potential of the trout pond.

4.1 Operational Options

The Vermilion Trout Pond and Dam will have features that will offer several operational options for controlling water quality problems (Figure 2). One of these features is the drop inlet. The drop inlet will be used to control the pond's water level. The drop inlet can act like a skimmer and remove surface populations of algae, but it will only do so when the pond elevation is above FSL. Under natural conditions, this will occur most frequently during the spring runoff period when algae are generally not a problem. Periodically, summer storm events of a large magnitude will raise the pond elevation high enough to allow skimming when algae numbers are high. However, it is expected that this skimming action of the drop inlet would only slightly improve water quality during these short periods of summer runoff.

The presence of a low level outlet on the proposed dam also offers potential for management of the pond water quality. Although the low level outlet is intended for use only when servicing or maintenance operations require the pond's water level to be drawn down, it could also be used at other times. During spring runoff and large summer storm events, the low level outlet could be opened and oxygen-poor, nutrient-rich hypolimnion waters could be removed and replaced by the runoff. Quality of runoff water is expected to be poor, but may be better than released bottom water. The operation of the low level outlet and the skimming properties of the drop inlet will probably not improve water quality in the pond significantly due to the overriding considerations of starting water quality and runoff water quality.

4.2 Downstream Impacts

Once in operation, the Vermilion River Trout Pond and Dam will alter the outflow water quality downstream of the pond. Under natural conditions, runoff from the basin area would flow unimpeded through the ravine and into the Vermilion River (Reservoir). Once in place, the project will intercept the basin runoff, mix with the pond water, and flush through the system. As the potential flushing rate of the pond is relatively

POSSIBLE OPERATIONAL OPTIONS FOR IMPROVING WATER QUALITY

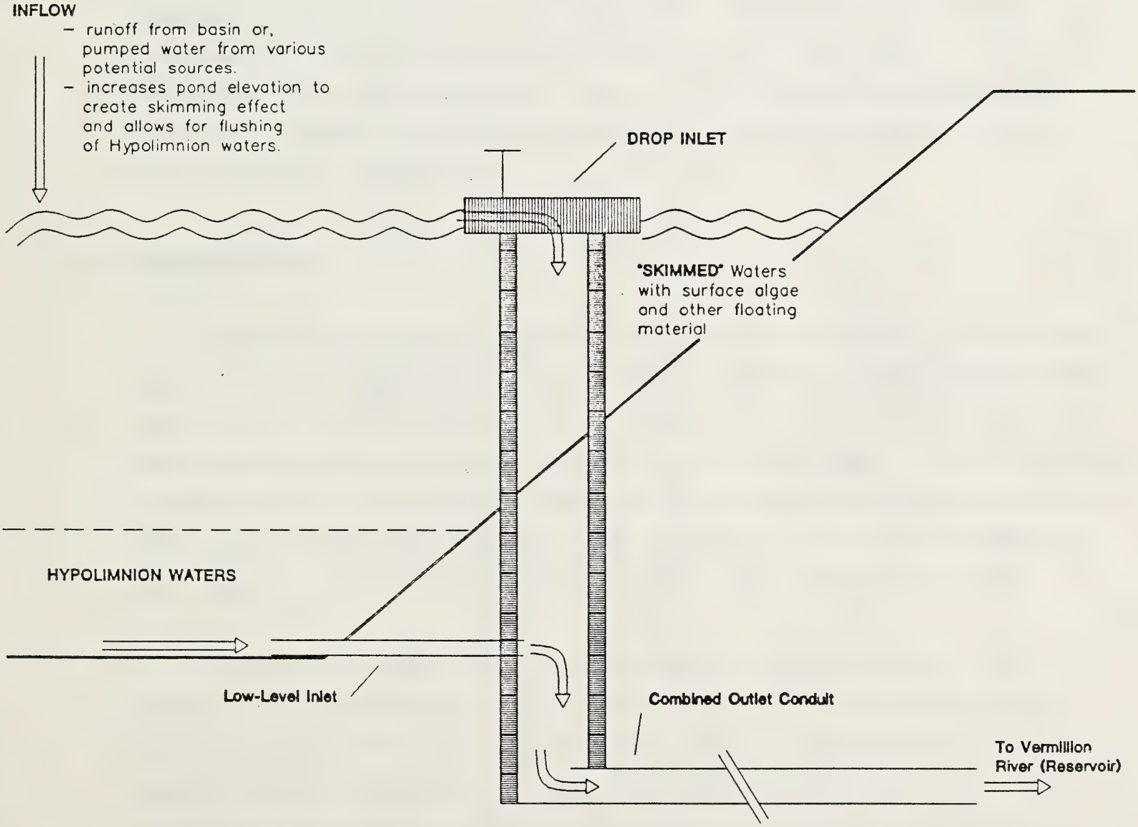
INFLOW
– runoff from basin or, pumped water from various potential sources.
– increases pond elevation to create skimming effect and allows for flushing of Hypolimnion waters.
DROP INLET
"SKIMMED" Waters with surface algae and other floating material
HYPOLIMNION WATERS
Low-Level Inlet
Combined Outlet Conduit
To Vermillion River (Reservoir)

FIGURE 3

rapid (average yearly turnover rate of 96%), water quality of the downstream release from the dam will be similar to the water quality of runoff under natural conditions. Water released from the pond during summer and fall could have higher concentrations of organic material, nutrients, and other water quality parameters than natural runoff.

The potential impact water releases from the pond would have on the Vermilion River (Reservoir) can be evaluated by comparing the volume of the release from the project, with the volume of water flowing in the Vermilion River. At the Water Survey of Canada Monitoring Station (05EE001 - Vermilion River near Mannville), the mean yearly volume is 34,900 dam^3. The predicted yearly outflow from the project is 73.0 dam^3, or 0.21% of the Vermilion River flow. It is therefore expected that downstream releases from the project will have little impact on the Vermilion River (Reservoir).

4.3 Recommendations

Hypereutrophic start up water, relatively poor quality runoff water, and insufficient wind aeration are factors expected to negatively affect water quality in the Vermilion Trout Pond. Thus, survival of trout is questionable and recreational opportunity is diminished. It is therefore recommended that some form of aeration for the pond be used to maintain high oxygen levels and adequate water quality. It is also recommended that start up water for the pond be of the best available quality.

It should be noted that the water quality data available from the reservoir is fifteen years old. The reliability of this data and its accurate representation of the reservoir may be questionable. Land use practices within a basin can change and subsequently alter river and reservoir water quality. Reservoir morphology changes over time, new sediments accumulate, and this can affect water quality. It is therefore recommended that water quality testing be done on the reservoir prior to any final decision to pump water from the reservoir.

In the summer of 1990, water samples will be taken from the Vermilion River (Reservoir). Results from this sampling program are expected to be available sometime after August 1990. This sampling program will update water quality information on the Vermilion River (Reservoir) and aid in future water management decisions regarding the Vermilion Trout Pond and Dam Project.

5.0 LANDSCAPING

The present plan for the trout pond specifies a water level 1.5 m above the original 1976 design level of the trout pond. This will raise the water level of the pond above the ravine. It is therefore necessary to enclose most of the pond with saddle dykes. The saddle dykes will reduce the drainage area of the pond, but the reduction is expected to be small.

Due to the necessary presence of the saddle dykes, the pond will lack a natural appearance. To reduce this visual incongruity, the saddle dykes should be landscaped in such a way as to blend the dykes into the natural area. Natural grasses and trees should be planted in the area and urban parklike features should be minimized. It is recommended that landscaping on the inside slopes of the dykes be done in such a fashion as to discourage potential damaging activities (i.e., snowmobiling, bike riding, hiking, etc.).

6.0 CONCLUSIONS

Based on the information available, the Vermilion Trout Pond and Dam Project will have minimal negative impact on lands and water in and surrounding the project site. The primary areas of concern with this project are potential impacts on downstream ravine habitat, and the water quality of the pond.

The lower ravine includes habitat important to ungulates, upland game birds, small mammals, and avian predators. Construction activities within this area should be avoided as much as possible. The existing trail within the ravine should not be upgraded as this could increase human traffic and subsequently increase the level of disturbance in the area.

The predicted water quality of the trout pond, with a water supply from the Vermilion River (Reservoir) and without artifical aeration, is expected to negatively affect the recreational potential of the pond and its ability to maintain a fishery. Pending the results of additional water quality analyses, it is recommended that initial start up water be of the best quality available and that some program of aeration be implemented to maximize the benefits associated with the proposed Vermilion Recreation and Trout Pond.

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